CLAIMS

What is claimed is:

1. A diamond composite heat spreader, comprising:

a diamond-containing material having a variable thermal conductivity gradient which substantially decreases from a heat influx region to a heat exit region of the diamond-containing material.

2. The heat spreader of claim 1, wherein the thermal conductivity gradient is substantially determined by variations in volume concentration of diamond.

3. The heat spreader of claim 2, wherein the variations in concentration are a substantially continuous decrease in the diamond concentration from the heat influx region to the heat exit region.

4. The heat spreader of claim 2, wherein the variations in concentration are a plurality of discrete regions each having a different concentration of diamond particles.

5. The heat spreader of claim 2, wherein said diamond-containing material further comprises a plurality of regions including the heat influx region and the heat exit region, such that each region has a lower concentration of diamond particles than an adjacent region which is nearer the heat influx region.

6. The heat spreader of claim 2, wherein the variations in volume concentration of diamond are within the range of about 30% to about 95% by volume diamond.

6. The heat spreader of claim 1, wherein the thermal conductivity gradient is determined by providing a plurality of regions having a varying mean free thermal path across diamond material.

7. The heat spreader of claim 6, wherein the varying mean free thermal path is determined by varying average diamond particle size along the thermal conductivity gradient.

8. The heat spreader of claim 7, wherein said diamond-containing material further comprises a plurality of regions including the heat influx region and the heat exit region, such that each region has a smaller average diamond particle size than an adjacent region which is nearer the heat influx region.

9. The heat spreader of claim 1, wherein the heat influx region comprises diamond film.

10. The heat spreader of claim 9, wherein the heat influx region has a thickness of from about 0.1 mm to about 1 mm.

11. The heat spreader of claim 10, wherein the heat influx region has a thickness of from about 0.3 mm to about 0.7 mm.

12. The heat spreader of claim 9, wherein the diamond-containing material further comprises a diamond particulate region adjacent the heat influx region, said diamond particulate region including a plurality of diamond particles.

13. The heat spreader of claim 12, wherein the plurality of diamond particles are each substantially in contact with at least one other diamond particle.

14. The heat spreader of claim 13, wherein substantially each diamond particle is sintered to at least one other diamond particle.

15. The heat spreader of claim 13, wherein the diamond particulate region further comprises an interstitial material.

16. The heat spreader of claim 15, wherein the interstitial material is selected from the group consisting of Cu, Ag, Al, and alloys thereof.

16. The heat spreader of claim 12, wherein the heat influx region is formed directly on the diamond particulate region.

17. The heat spreader of claim 12, wherein the heat influx region is brazed to the diamond particulate region.

18. The heat spreader of claim 1, wherein the diamond-containing material is interference fitted into a non-carbonaceous mass.

19. The heat spreader of claim 18, wherein the non-carbonaceous mass is copper.

20. The heat spreader of claim 1, wherein the diamond-containing material is brazed into a non-carbonaceous mass.

20. The heat spreader of claim 1, wherein the heat spreader includes a plurality of heat influx regions.

21. The heat spreader of claim 1, wherein the heat spreader includes a plurality of heat exit regions.

22. The heat spreader of claim 1, wherein the heat influx region has a thermal conductivity of about 2400 W/mK and the heat exit region has a thermal conductivity of about 600 W/mK.

23. A method of making a heat spreader, comprising the steps of:

a) defining a heat spreader volume;

b) identifying a desired predetermined temperature profile within the heat spreader volume based on an intended heat source; and

c) forming a diamond-containing material within the heat spreader volume having a variable thermal conductivity gradient configured to produce approximately the predetermined temperature profile during use.

24. The method of claim 23, wherein the step of forming the diamond-containing material includes packing a plurality of diamond particles in a predetermined pattern characterized by varying diamond particle sizes to form a diamond particulate region.

25. The method of claim 24, wherein packing is accomplished by placing a first layer of diamond particles in a mold and then placing one or more additional layers of diamond particles adjacent one another such that each successive additional layer of diamond particles has a progressively smaller average diamond particle size than the first layer.

26. The method of claim 24, wherein a first plurality of diamond particles having a first average mesh size is packed and then packing successively smaller particles into interstitial voids in the first plurality of diamond particles to form a first diamond particle region.

27. The method of claim 26, wherein packing further comprises forming a second particle region by placing a second plurality of diamond particles adjacent the first diamond particle region and then packing successively smaller particles into interstitial voids in the second plurality of diamond particles to form a second diamond particle region.

28. The method of claim 24, further comprising step of forming a layer of diamond film adjacent the particulate diamond region.

29. The method of claim 28, wherein the step of forming is accomplished by depositing diamond film directly on a surface of the particulate diamond region via chemical vapor infiltration.

30. The method of claim 28, wherein the step of forming is accomplished by brazing the layer of diamond film to a surface of the particulate diamond region.

31. The method of claim 24, further comprising the step of interference fitting the particulate diamond region into a non-carbonaceous mass.

32. The method of claim 31, wherein said non-carbonaceous mass comprises copper.

33. The method of claim 24, wherein the step of forming further includes infiltrating the diamond particulate region with a non-carbonaceous material.

34. The method of claim 24, wherein the step of forming further includes sintering the particulate diamond region.

35. The method of claim 24, wherein packing results in substantially each diamond particle being in contact with at least one other diamond particle.

36. The method of claim 23, wherein the intended heat source is a CPU.